PERSPECTIVES AND COMPARISONS OF SMOKE EMISSIONS FROM HISTORIC AND MODERN FIRES: TAKING THE ELEPHANT OUT OF THE CLOSET AND PUTTING IT INTO THE STADIUM

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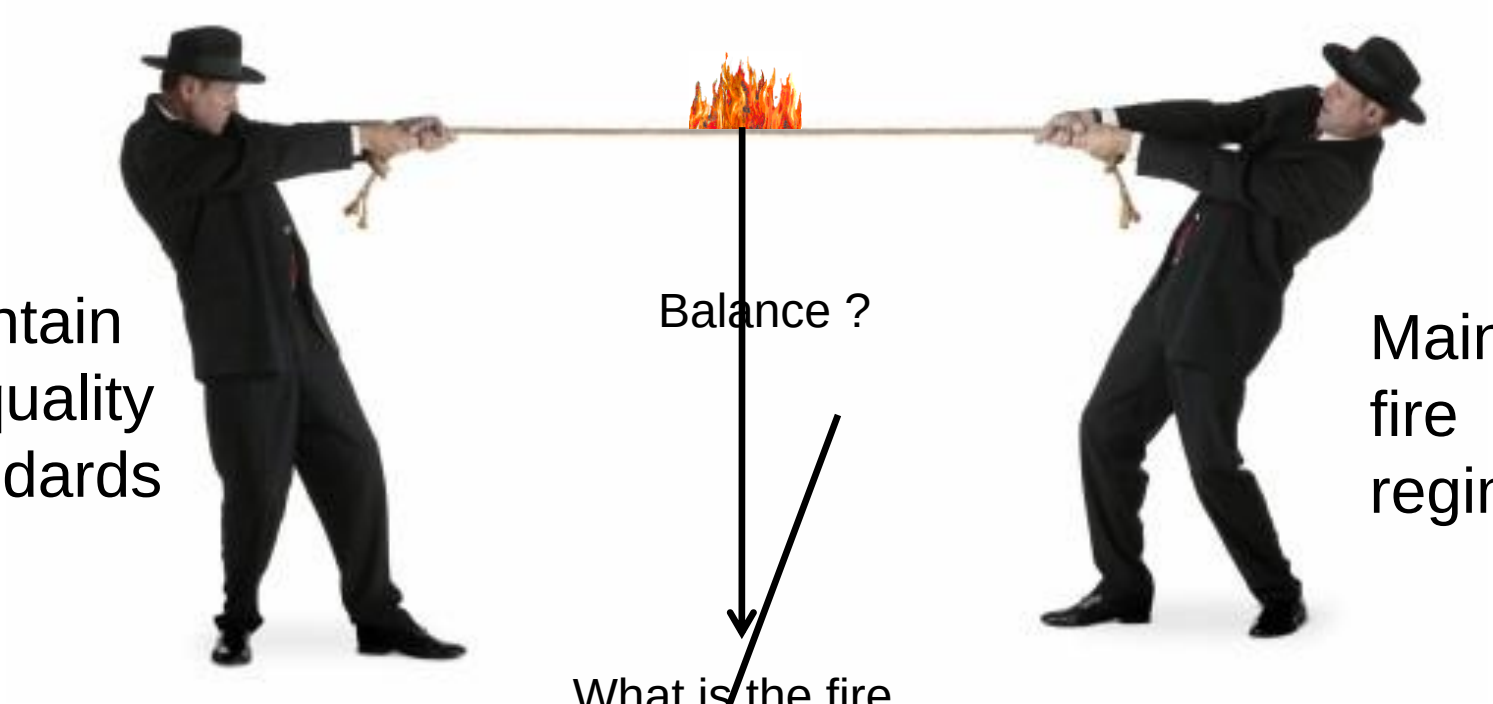
Problem Statement



Maintain air quality standards

Balance ?

Maintain fire regimes

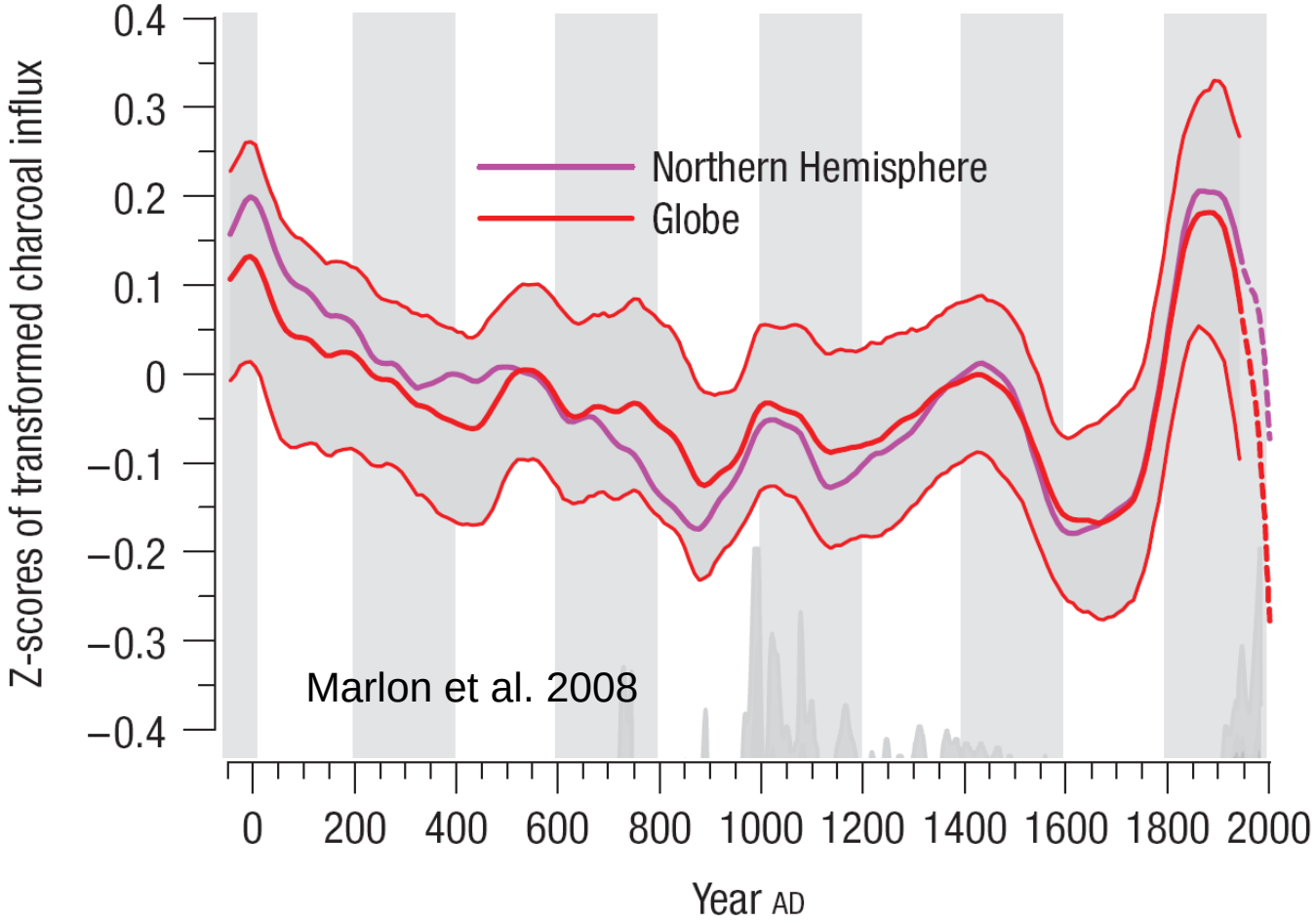
What is the fire emissions standard?

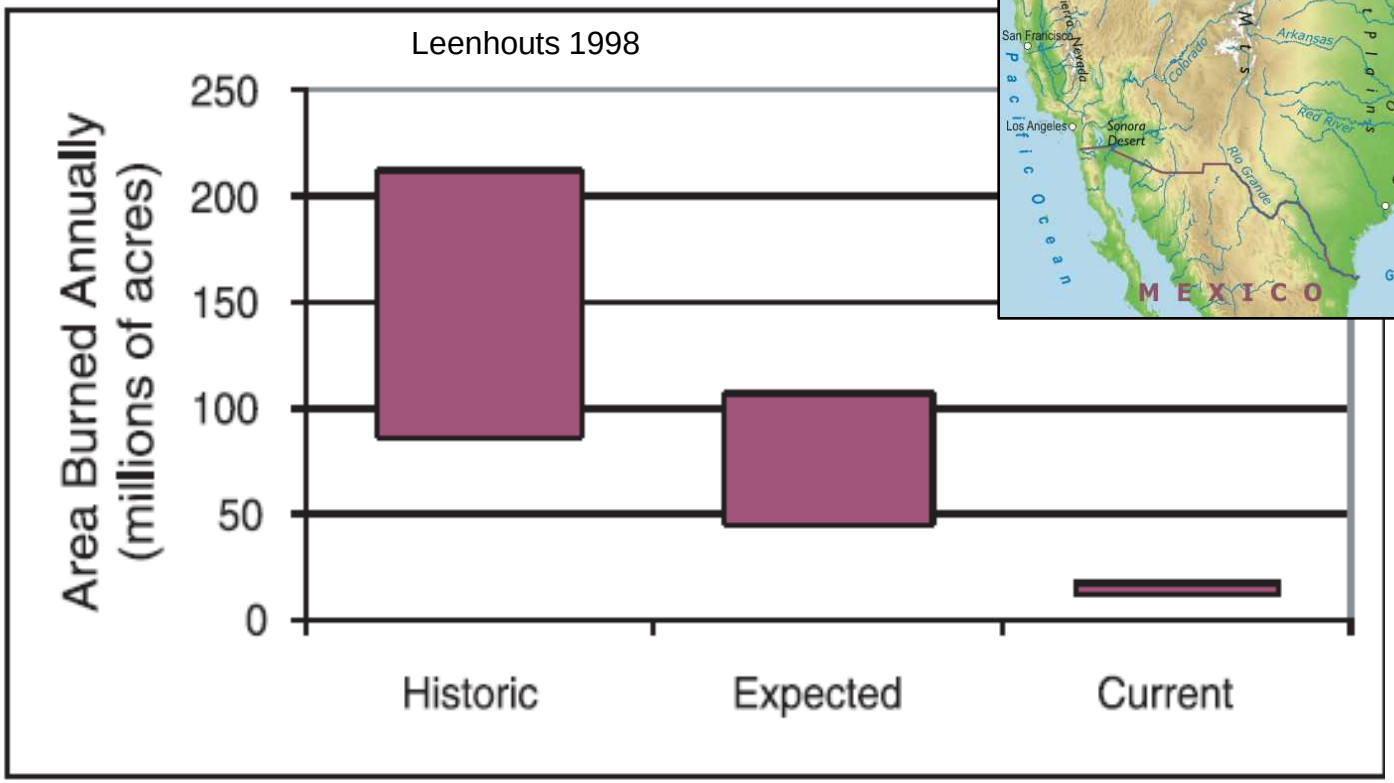
Historic emissions?
Current emissions?
Clean Air Act?

Problem Statement

- Basis for historic emissions knowledge
  - Perspective, keeps past from repeating itself
  - Pre-fossil fuel emissions
  - The historic frequency of fire created the biological communities we commonly yearn (burn) to achieve
  - What has suppression bought us/ how much do agencies reduce emissions?

Long-term variability in global fire





- Not spatially explicit
- How to use these data for determining historic emissions standards for states?

Objectives

- Demonstrate the relevance of a historic fire frequency model (PC2FM) for understanding presettlement emissions (spatial variability)
- Compare historic and current emissions
- Discuss the scale and variability of emissions
  - elephant from closet to stadium

Estimating emissions

Single events

- Emissions (tons) = Fuel consumption * Emission factor * Area burned

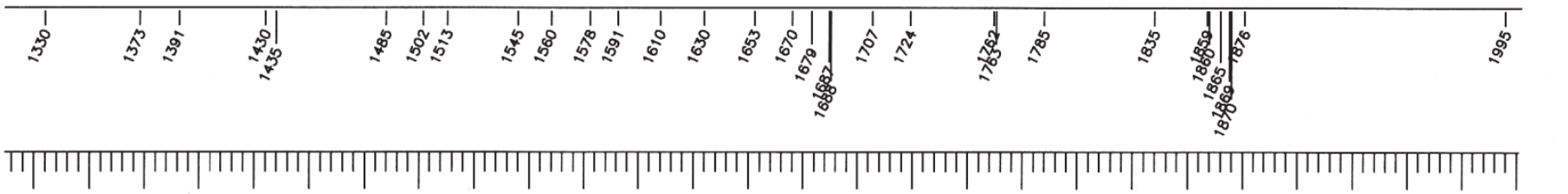
Multiple events, long-term

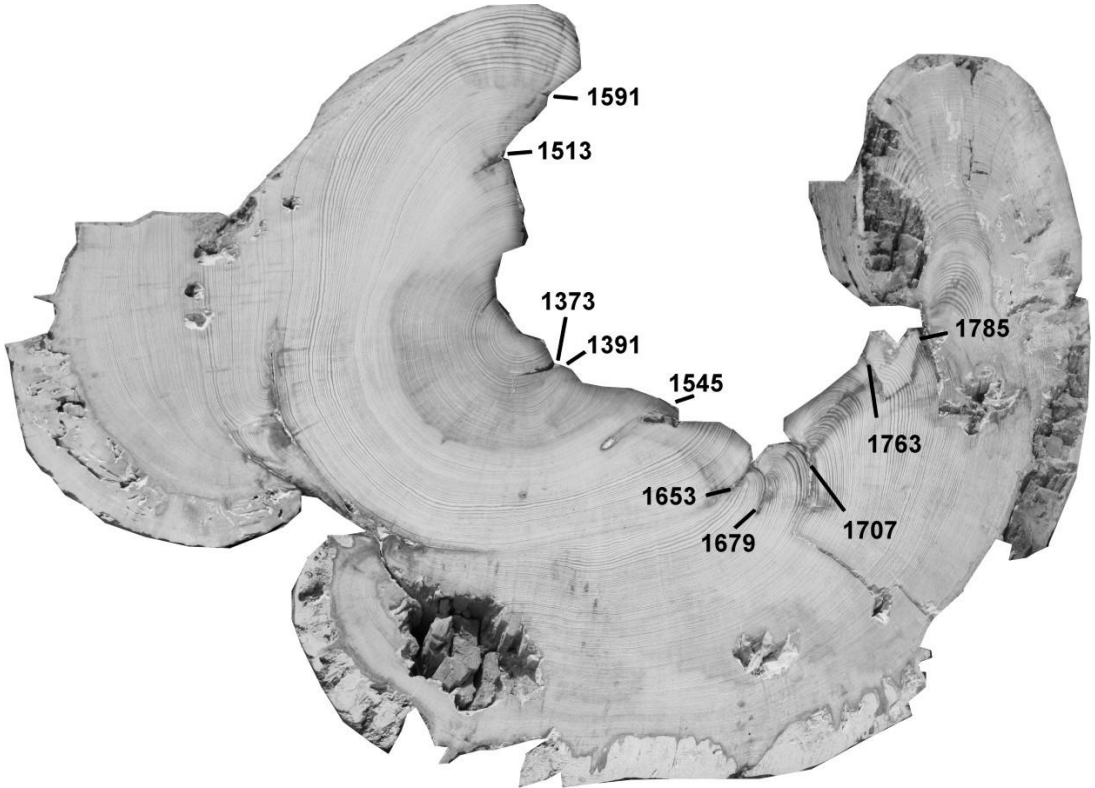
- Fire frequency
- Fuel accumulation rates
- Changes in biophysical settings / vegetation

2006, Chadron Nebraska

1) Fire Frequency (rate of emissions)

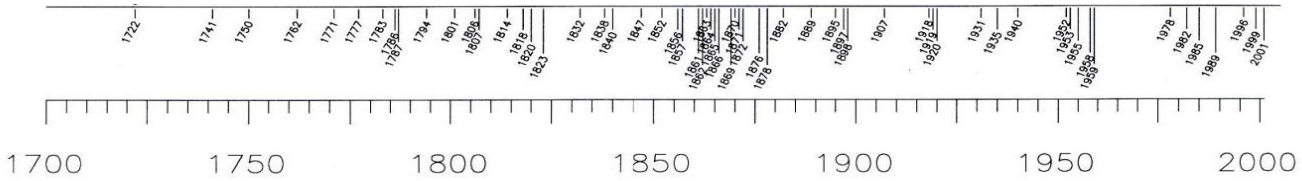
Devils Tower, Wyoming (MFI = 24.6 yrs)



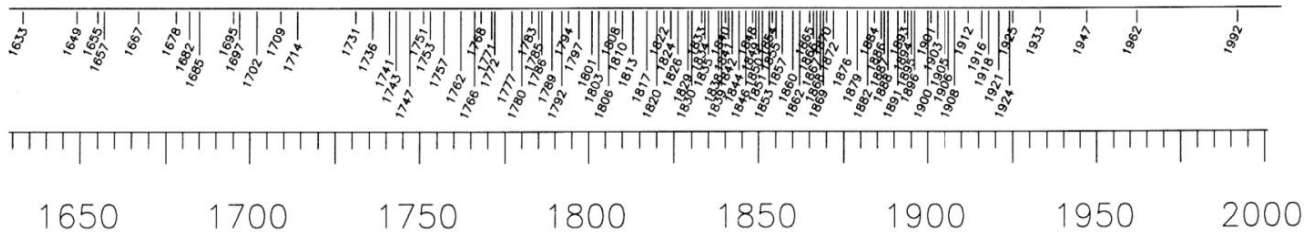


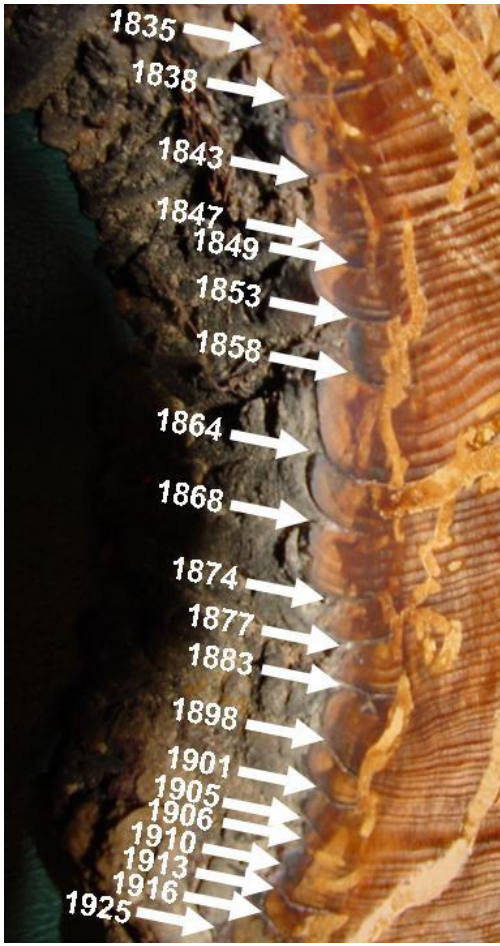
1) Fire Frequency (rate of emissions)

Wichita Mtns., Oklahoma (4.7 yrs)

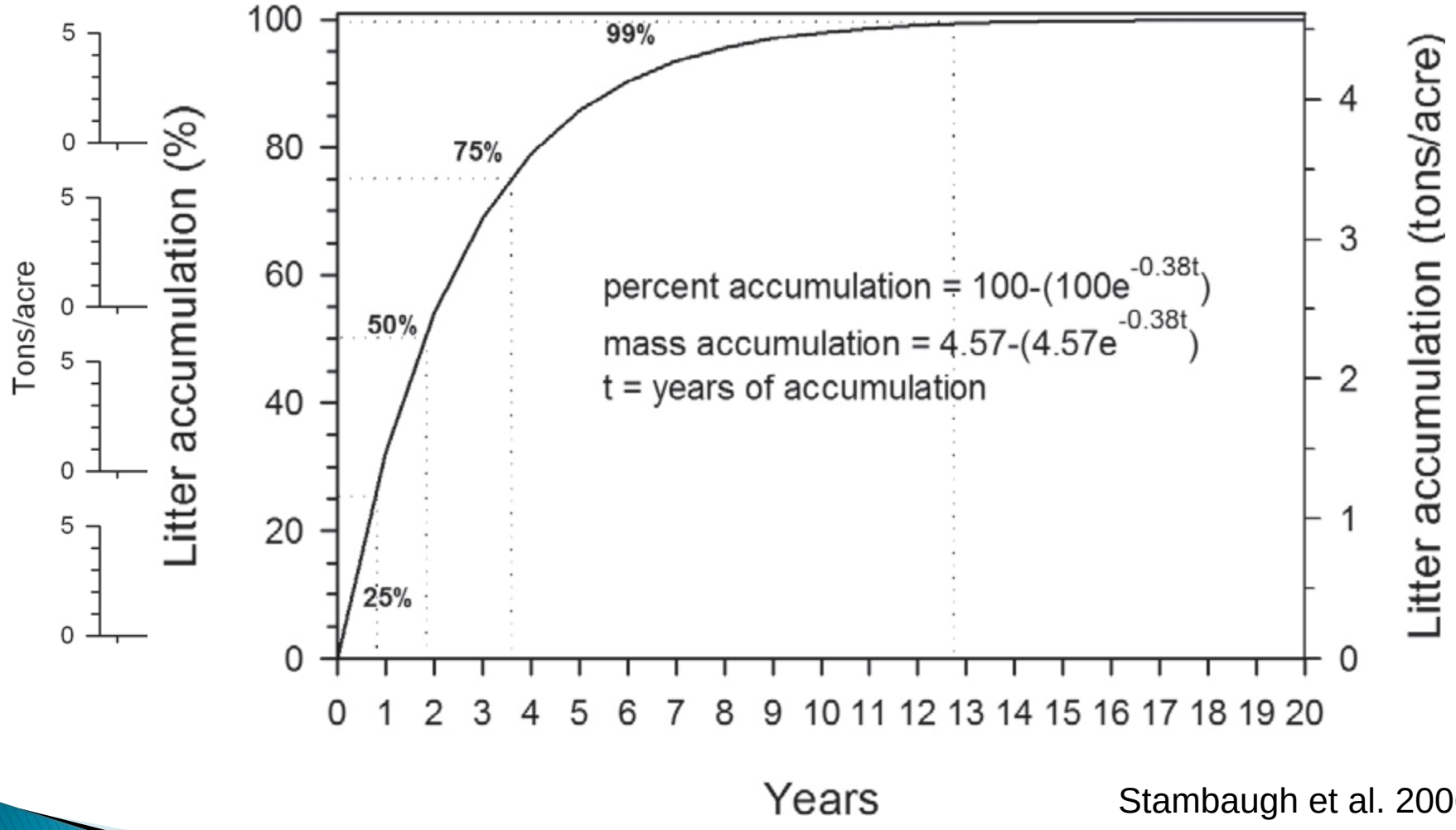


Ozark Highlands, Oklahoma (3.5 yrs)





2) Fuel accumulation (consumption)



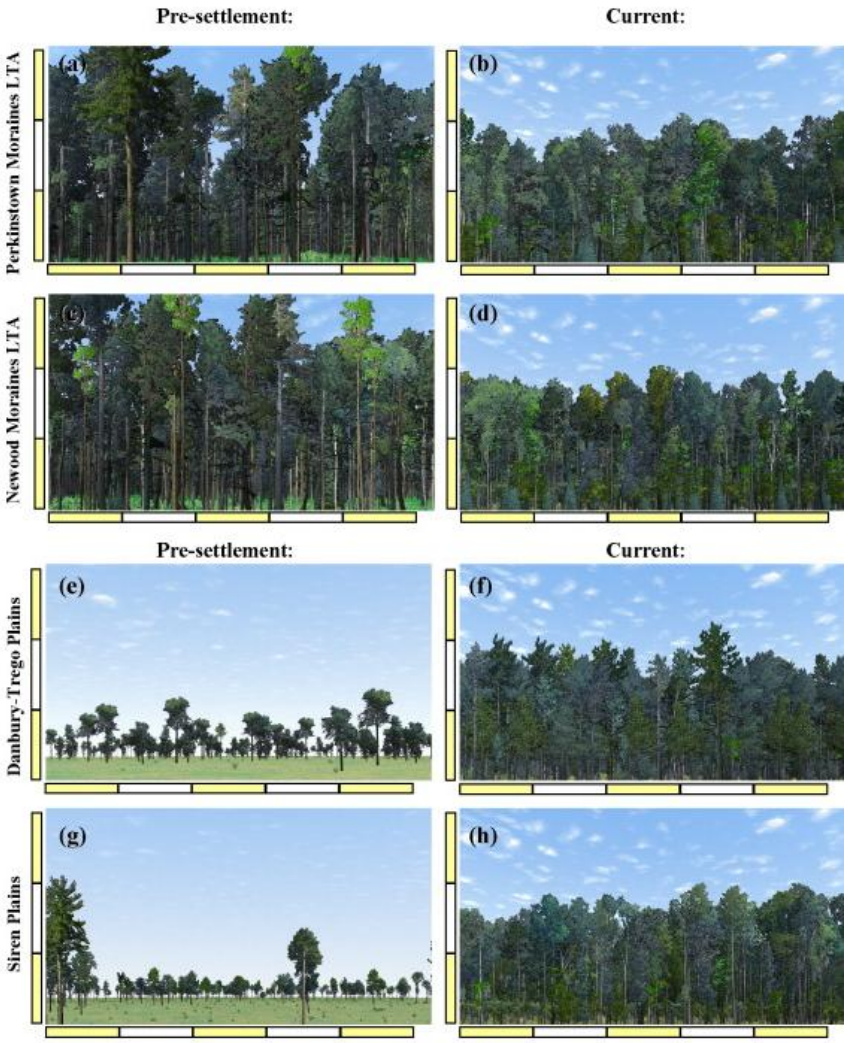
Stambaugh et al. 2006

3) Changes in biophysical settings (BpS) (Emissions factors)

The vegetation that was dominant prior to EuroAmerican settlement

- Structure: Savanna to closed forest
- Composition: Pine to hardwood

- Differences between historic and current fuel conditions



Stoltman et al. 2007

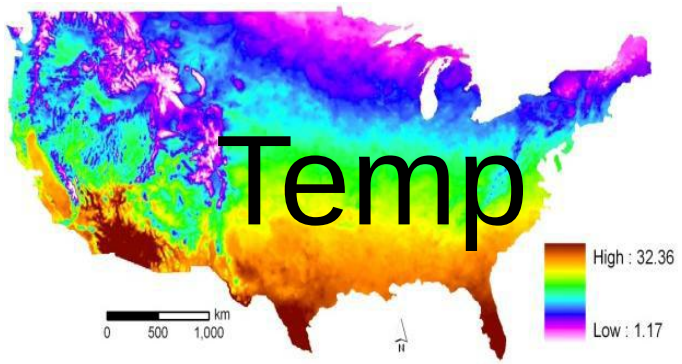
PC2FM → scaling reaction rates from the laboratory to the landscape

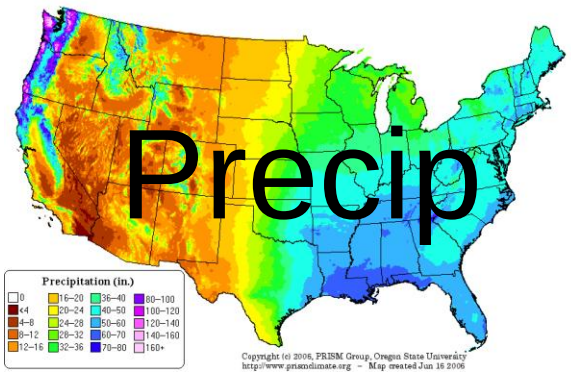
The process or mechanistic formulation for prediction:

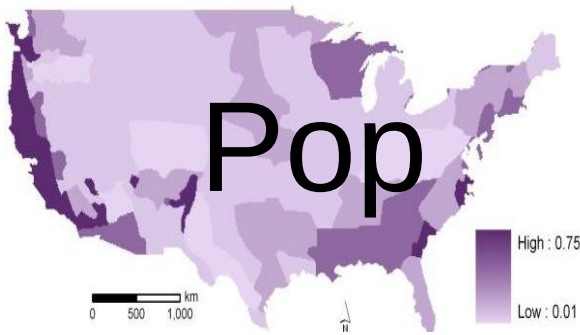
$$MFI = Ce^{-((0.139*maxt) + (1.50*moisti) - (2.41*pop) + (0.00763*precip))}$$

where: **MFI** is the mean fire interval (years),
C is a constant (59.12),
e is 2.718,
maxt is average maximum temperature (ºC), partial $\mathbf{r^2}$ = 0.30
moisti the reciprocal of a moisture index 1/(***precip/maxt***), partial $\mathbf{r^2}$ = 0.23
pop is human population density (humans per km^2), partial $\mathbf{r^2}$ = 0.12
precip is mean annual precipitation (cm), partial $\mathbf{r^2}$ = 0.10

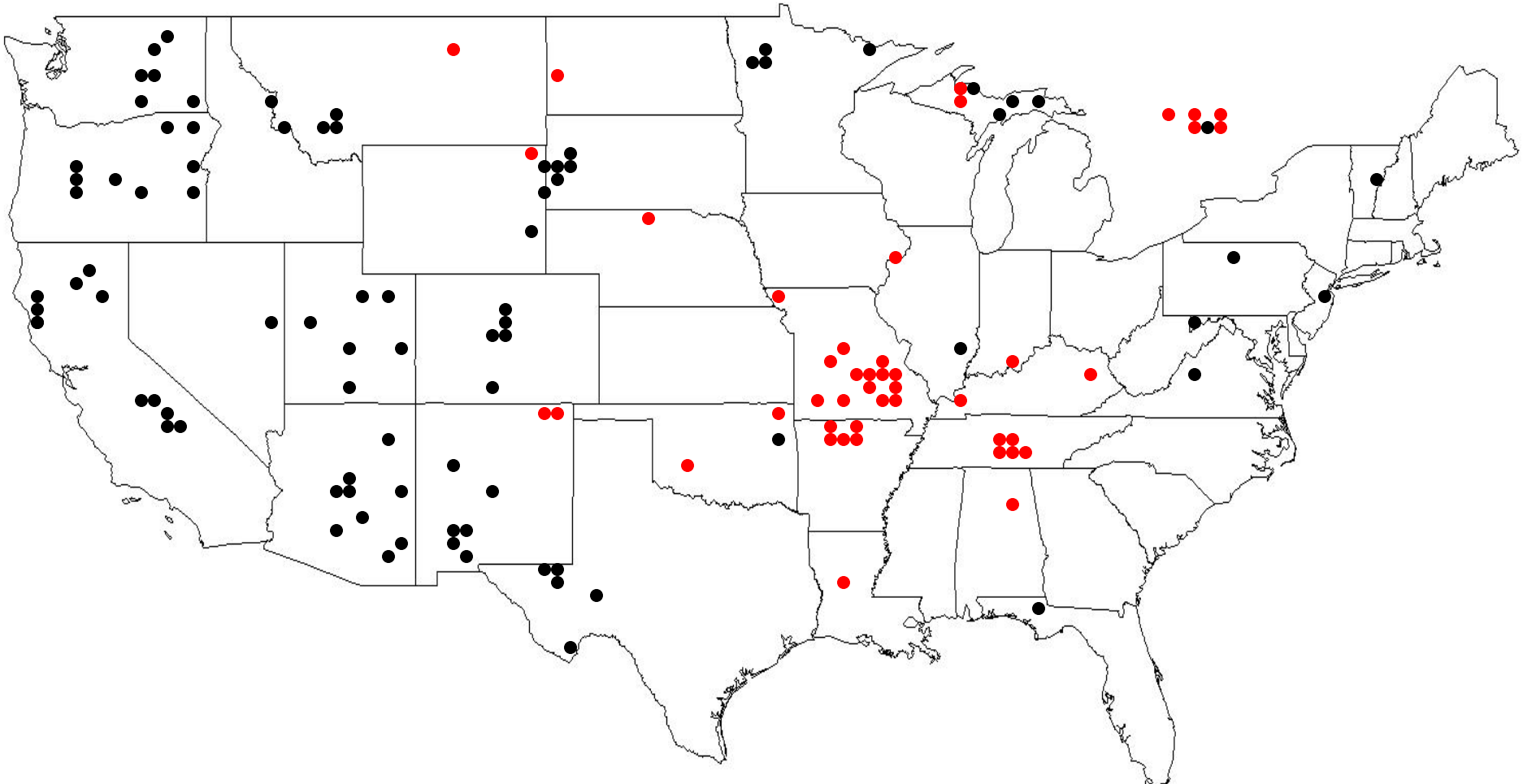
model $\mathbf{r^2}$ = 0.75, (tested)
period of calibration:~1650 and 1850 AD.
number fire history sites, model = 78, tested on 155 with replacement.



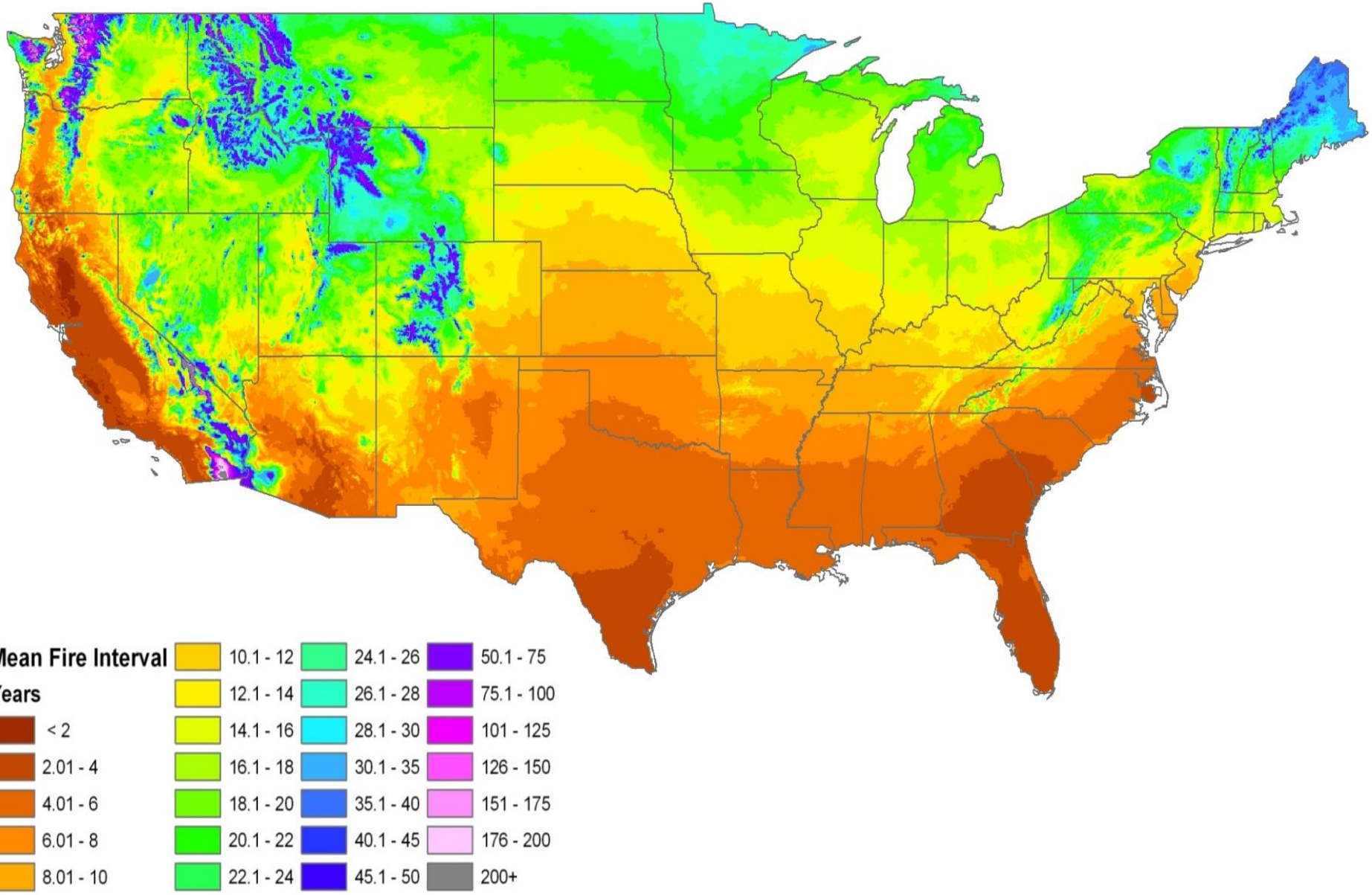




Mean fire interval (MFI) data from fire history publications, the International Multiproxy Paleofire Database, and the Missouri Tree Ring Lab (red)



Pre-EuroAmerican mean fire intervals
~ AD 1650 -1850

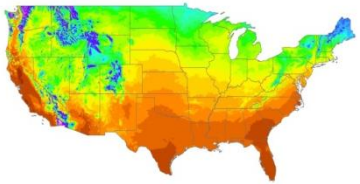


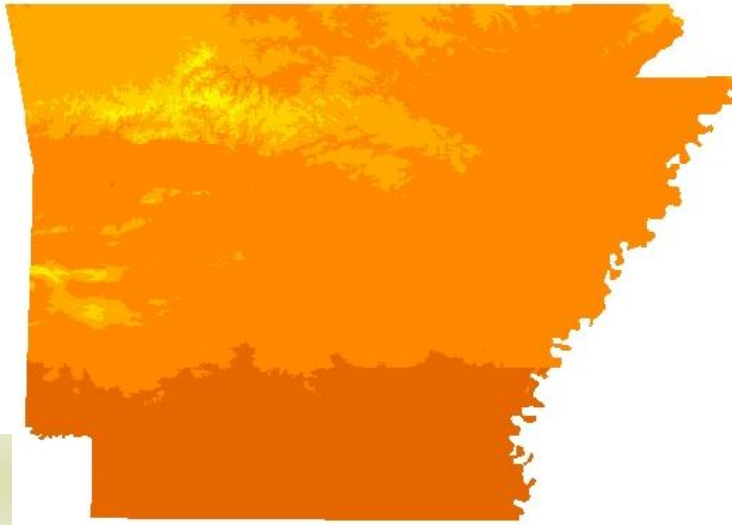
Historic and present emissions

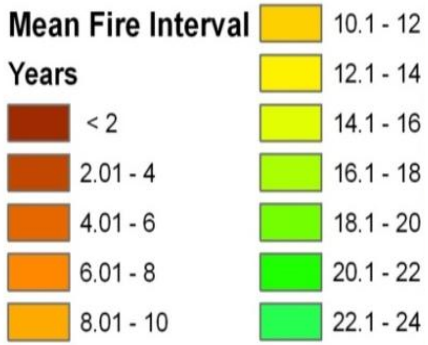
Arkansas:

past: 34,000,000 acres,
Statewide average mean fire interval (MFI) = 7 years

present: 100,000 acres (prescribed)

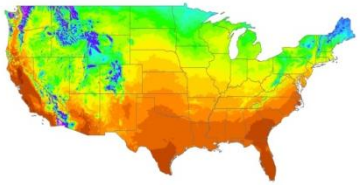






Time Period	Current	Current	Historic
Description	Initial burn	Maintenance burning	"Natural"
Fire Interval	na	7	7
Fuels	FCCS fuelbed value	Defined	Defined
Treatment type	Prescribed	Prescribed	Wildfire
Fuelbed size (acres)	100,000 / yr	100,000 / yr	4.8 million / yr
Loading (tons/ac)	44.03	25.38	23.33

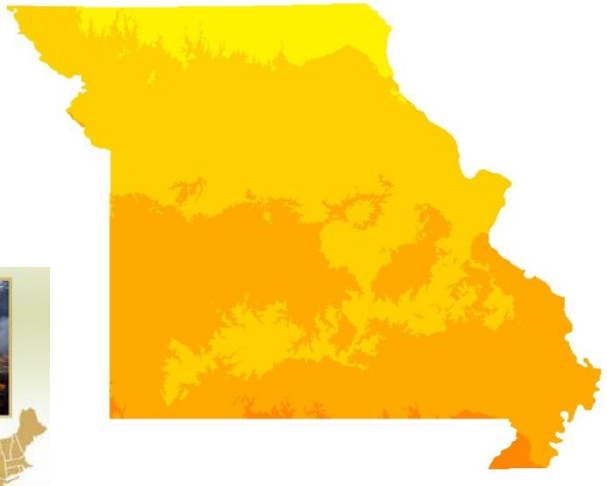
Historic and present emissions



Missouri:

past: 44,000,000 acres, MFI = 11

present: 106,000 acres (wildfire & prescribed)

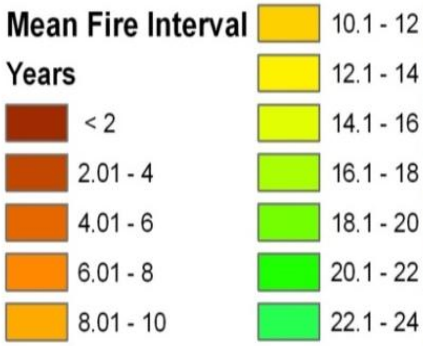


Annual Consumption

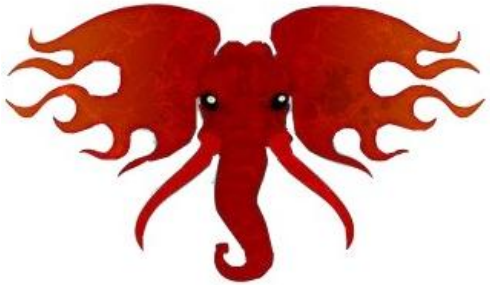
1,378,000 tons (present)

52,594,712 tons (past)

2%



Estimating historic emissions

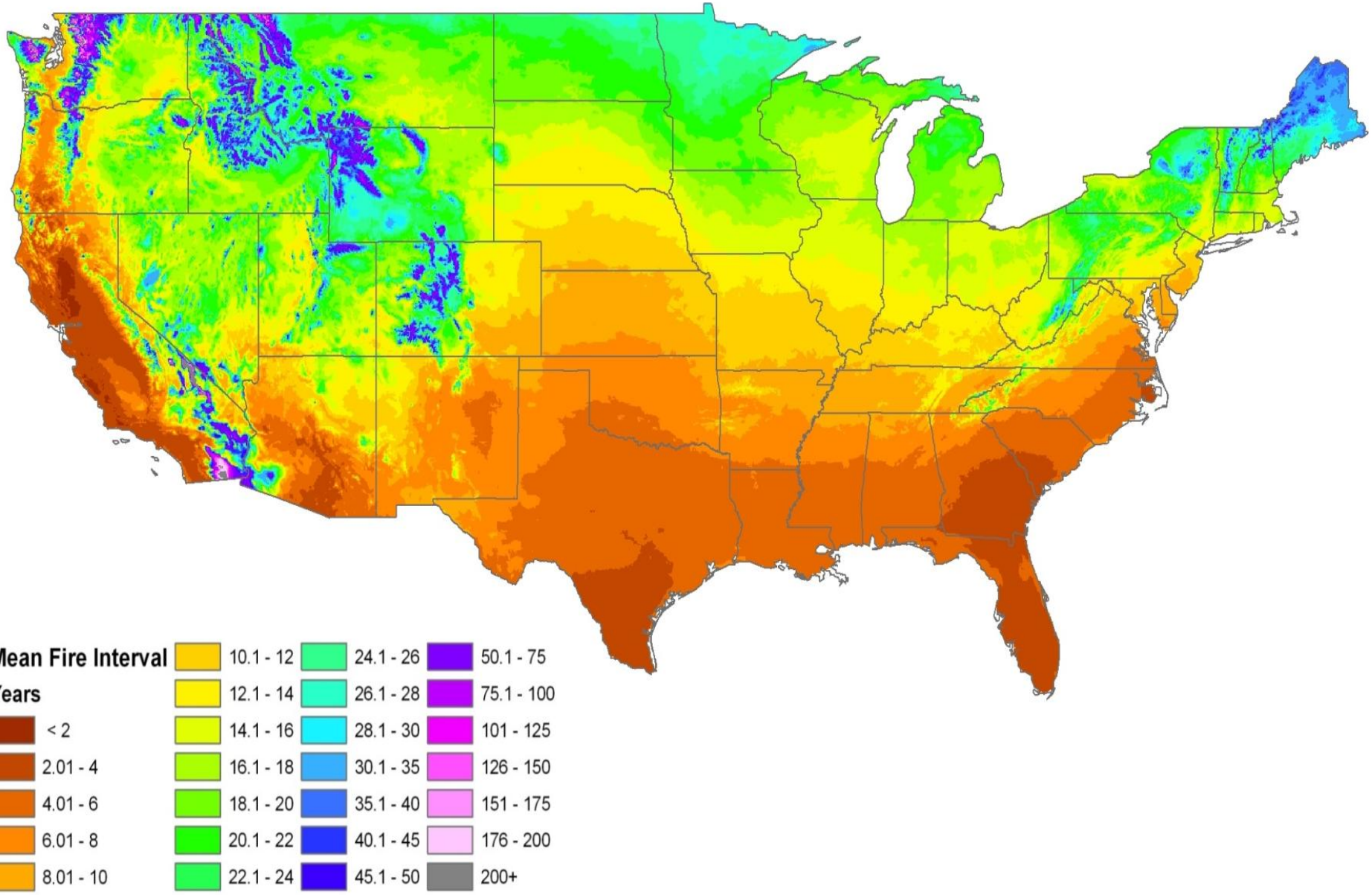


= Fuels x Emission Factor ÷

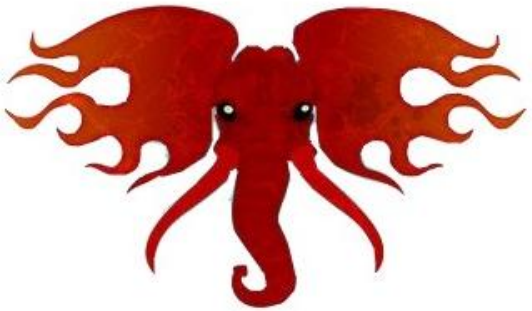
Loading
Biophysical setting
Fuel type
Consumption

Rate of emissions
Fire History

Pre-EuroAmerican mean fire intervals
~ AD 1650 -1850



Fire frequency is the elephant in the closet



- Fire frequency is a big issue that is disregarded, historic importance overlooked
- Historic and large scale emissions are too big of an issue to fit through the closet door and, even if shoved out, how would we address them?
- The issue is too large and is going to break its confines
- Emissions deserve larger and longer term historic and ecosystem consideration, being in closet hides its features

Elephant in the Stadium

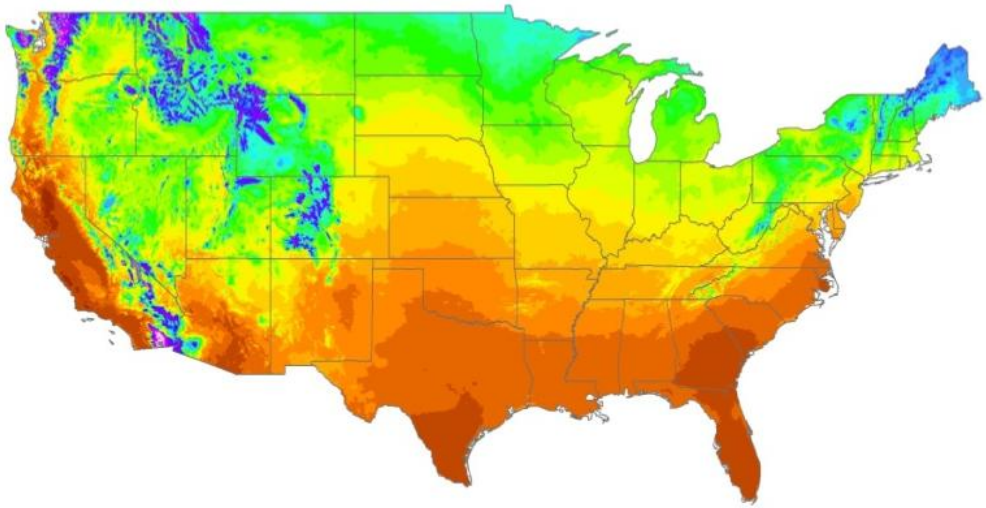
- Need to see the elephant

  - How do emissions vary temporally and spatially?
  - How much do agencies suppress or reduce emissions? How do current emissions compare to historic?

Lack of information about burning costs vs. benefits (forest “mesophication”, decline of fire dependent species, megafires)

Elephant in the Stadium

- State-level differences between current emissions and historic emissions may be estimated by differencing the numbers of acres burned
- Between state differences in historic emissions exist
- Emissions standards could consider the variability between locations



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